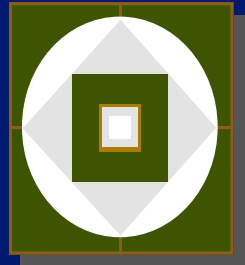


MRI Safety Issues

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MRI Safety *Issues*

- ★ Lack of Required, Annual & On-going **Education & Training**
 - ✓ Policies & procedures
 - ✓ Pre-procedure screening
 - ✓ Patient preparation
 - ✓ Positioning, immobilization & insulation
 - ✓ Patient communication

MRI Safety *Issues*

- ★ Lack of Focus on **Patient Burns** due to:
 - ✓ Radio Frequency Magnetic Fields
 - ✓ Varying Gradient Magnetic Fields

How do we differentiate?

How do we protect & prevent?

Static Main Magnetic Field Effects (B_0)



RF Magnetic Fields (B_1)



**Education,
Training,
Knowledge
& Support**



RF Magnetic Fields (B_1)

Risks: Heating of metal or device, associated components, and/or surrounding tissues due to:

- ★ Exposure (close proximity) to transmit RF coil
- ★ Focus in area (antenna effect)
- ★ Currents induced in conductive devices
 - ✓ Cable forms loop with itself
 - ✓ Cable forms loop with other cable
 - ✓ Cable forms loop with human body
 - ✓ Human body forms a loop with itself
 - ✓ Overlapping stents or other devices
- ★ Cable or human touches magnet bore wall
- ★ Malfunction or inappropriate use of a RF coil

Varying Gradient Magnetic Fields

Risks: Currents induced in conductive devices resulting in heating of metal or device, associated components, and/or surrounding tissues.

- ★ Risks due to rapid switching

- ✓ Size (maximum amplitude)

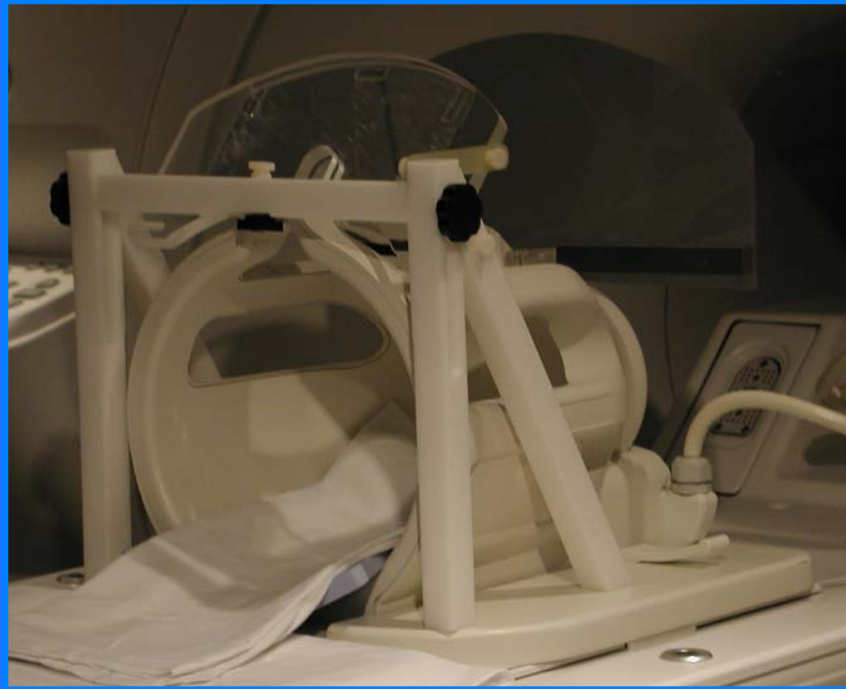
- 20-50 mT/m or 2-5 gauss/cm

- ✓ Speed (slew rate)

- 120-200 mT/m/msec

- ★ Larger at ends of the gradient coil
(zero at center)

RF Magnetic Fields (B_1)

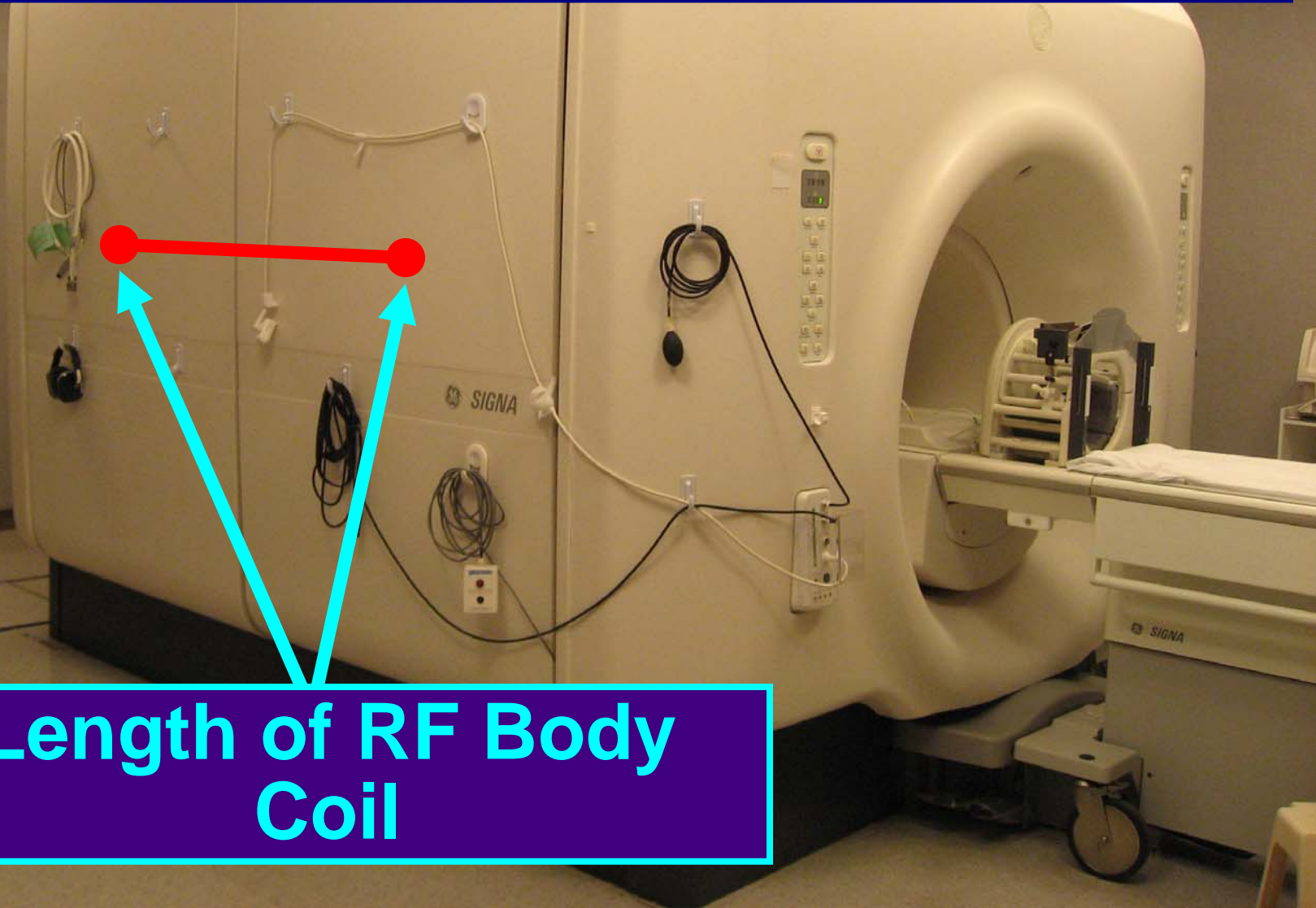


Receive-only Head coil



Transmit-Receive Head coil

★ Using the RF Body Coil as the transmit RF coil, transmission of RF occurs along the entire length of Body Coil, not only in area of receiving RF coil.

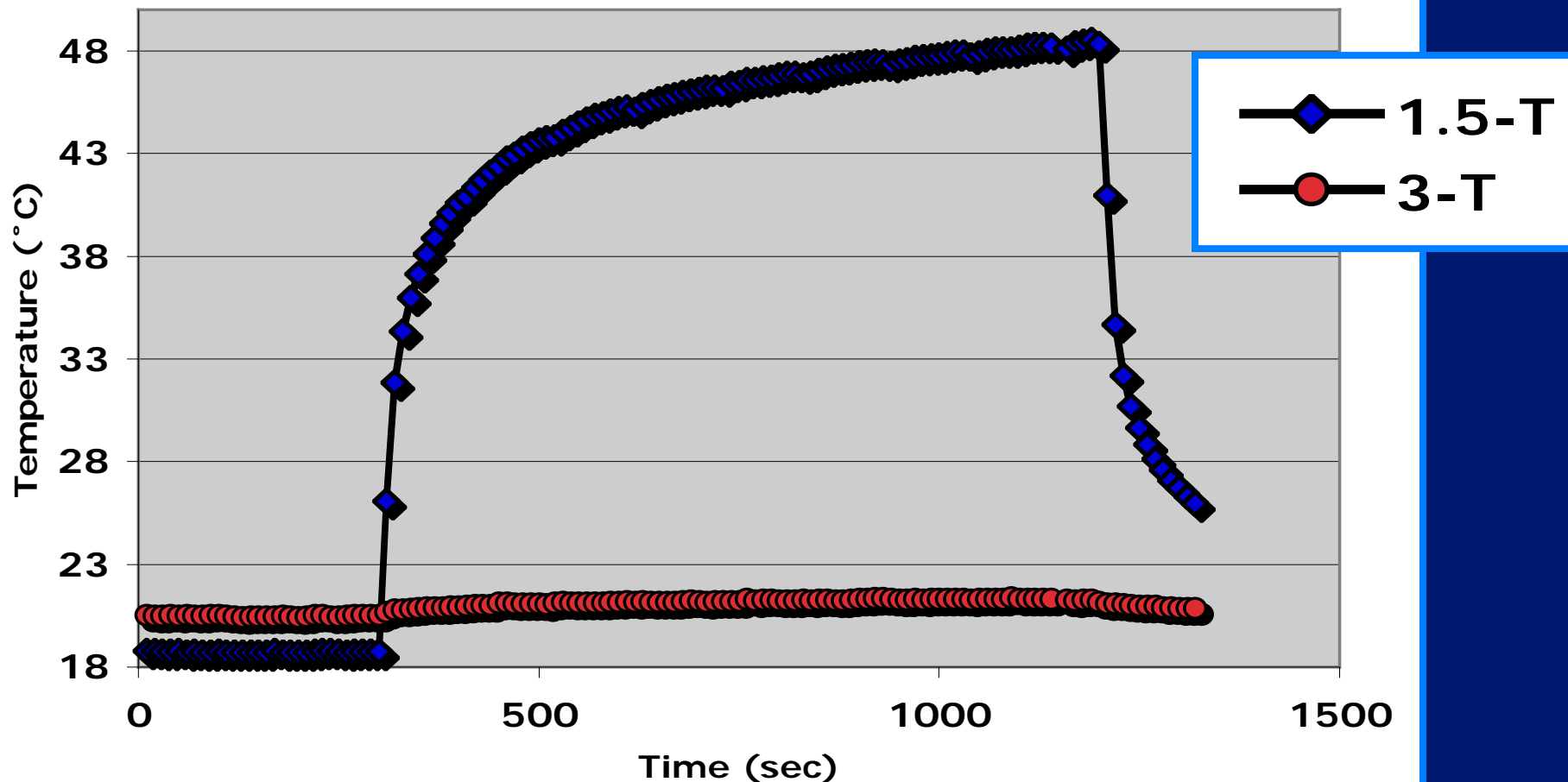


Length of RF Body Coil

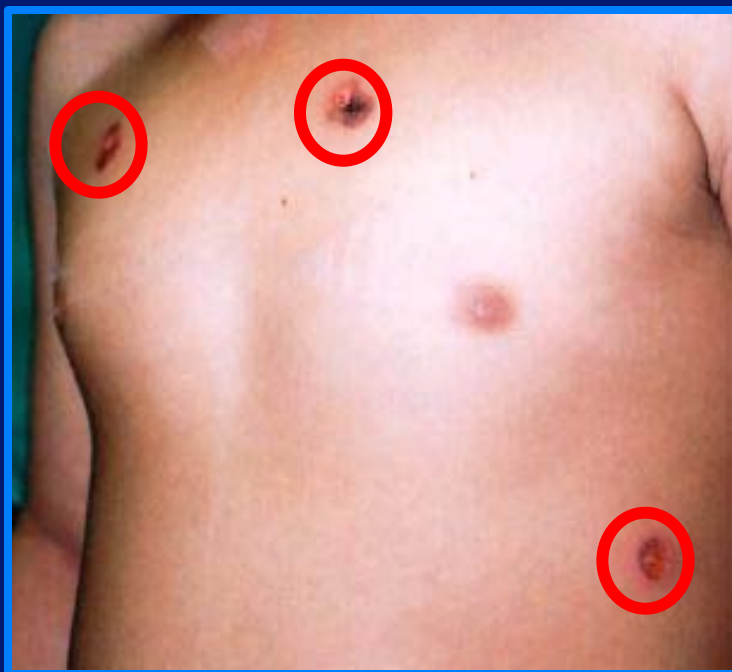
Resonant Wavelength

Courtesy Frank Shellock, PhD

1.5T (1.4 W/kg) vs. 3.0T (3 W/kg)



At certain lead lengths, less heating at 3.0T (128 MHz) vs. 1.5T (64 MHz) due to differences in resonant wavelength.



Positioning, Immobilization & Insulation

**Required use of
sponge pads to separate & insulate**



**$\frac{1}{4}$ inch (0.635 cm) of air
GUARANTEED**

Positioning, Immobilization & Insulation

Potential for

- ★ Induced electrical currents in loops & conductors
- ★ Excessive heating

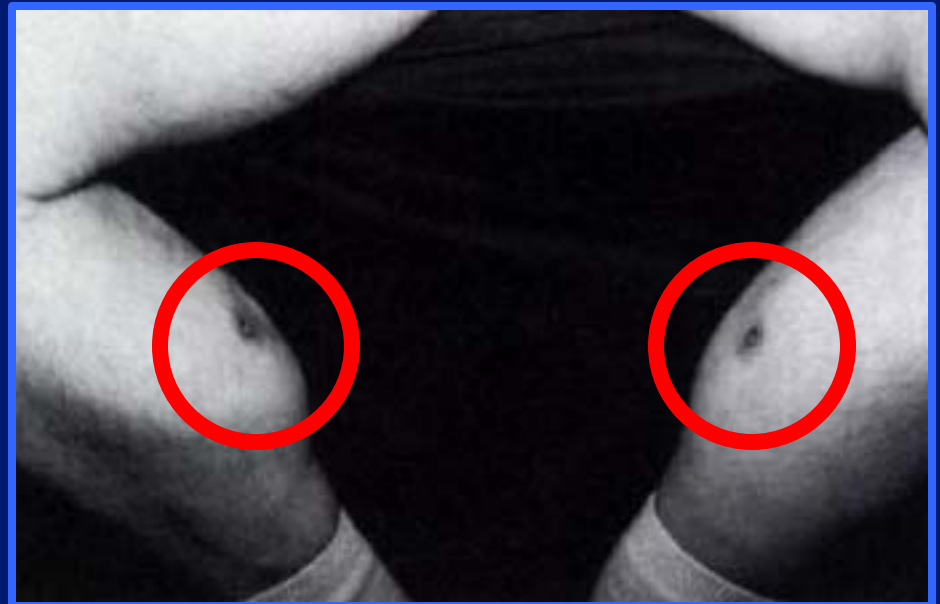


Positioning, Immobilization & Insulation



**Malfunction of the body coil
with arm resting against bore wall**

Positioning, Immobilization & Insulation

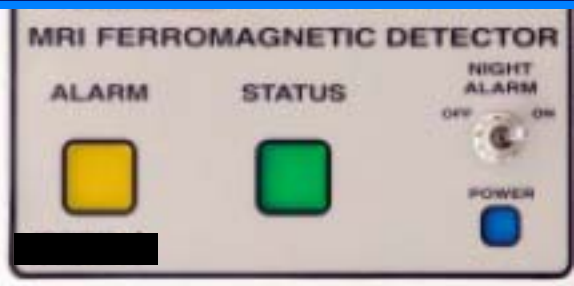


Potential Value of Ferromagnetic Detectors in MRI Screening

Issues

- ★ Over-dependence by users
- ★ Detects external metal, NOT internal
- ★ Generates false-positives & false-negatives
- ★ Function dependent on many variables
 - ✓ Motion rate of detector relative to metal
 - ✓ Size & mass of metallic object
 - ✓ Sensitivity setting of detector

Potential Value of Ferromagnetic Detectors in MRI Screening



Potential Value of Ferromagnetic Detectors in MRI Screening

*Restricted access is
only as good and as secure
as the MRI staff
who maintain it.*



Accident Prevention in MRI

★ Change out of street clothes



Accident Prevention in MRI

★ Change out of street clothes



**Focus your
concentration on
screening for
biomedical devices
and implants!**



Courtesy Ray Schmitz

***"What does
that alarm
mean?"***



Thank you for your attention!

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